Provider Adherence to a Clinical Practice Guideline for Acute Asthma in a Pediatric Emergency Department

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Abstract. Critics of the use of clinical practice guidelines (CPGs) in an emergency department (ED) setting believe that they are too cumbersome and time-consuming, but to the best of the authors' knowledge, potential barriers to CPG adherence in the ED have not been prospectively evaluated. **Objectives:** To measure provider adherence to an ED CPG based on National Asthma Education and Prevention Program (NAEPP) recommendations, and to determine factors associated with provider nonadherence. **Methods:** Prospective, cohort study of children aged 1–18 years with the diagnosis of an acute exacerbation of asthma who were seen in a pediatric ED and requiring admission, as well as a random selection of children discharged to home following pediatric ED care. The following adherence parameters were assessed: at least three nebulized albuterol treatments in the first hour; early steroid administration (after the first nebulizer treatment); clinical assessments using pulse oximetry and peak expiratory flow (PEF) (for children >6 years old); and use of a clinical score to assess acute illness severity (Asthma Severity Score). Nonadherence was defined as any deviation of the above parameters. **Results:** Between July 1, 1998, and June 30, 1999, 369 patients were studied. Of these, 38% (139) were discharged to home, 38% (140) were admitted to the observation unit, and 24% (90) were admitted to the inpatient unit. Illness severities at initial presentation to the ED were: 24% (86) had mild exacerbations, 59% (212) had moderate exacerbations, and 17% (62) had severe exacerbations. Sixty-eight percent (95% CI = 63% to 73%) of the patients were managed with complete adherence to the CPG. Of the 32% with some form of nonadherence, most (63%) were children older than 6 years; in this group 64% (48/75) were nonadherent due to lack of PEF assessment. When PEF assessment was disregarded, an 83% (95% CI = 79% to 87%) adherence to the CPG was achieved. Other nonadherence factors included: lack of at least three nebulized albuterol treatments provided timely within the first hour (5%); delay in steroid administration (6%); lack of pulse oximeter use (0.5%); and failure to record clinical score to assess severity (1.1%). Patient age, illness severity (acute and chronic), first episode of wheezing, and high ED volume periods (evenings and weekends) did not worsen adherence. **Conclusions:** Clinical practice guidelines can be used successfully in the pediatric ED and provide a more efficient management and treatment approach to acute exacerbations of childhood asthma. With a systematic and concise CPG, barriers to adherence in a pediatric ED appear to be minimal, with the exception of using PEF in the routine ED assessment. **Key words:** clinical practice guidelines; asthma; adherence; emergency care. ACADEMIC EMERGENCY MEDICINE 2001; 8:1147–1152

IN 1999, childhood asthma accounted for 5.6 million children in the United States, an increase of 80% since 1984.[1] The National Asthma Education and Prevention Program (NAEPP) convened the Consensus Panel 2 Report in 1997 for the management of asthma.[2] Several investigators have reported the importance of adherence to these evidence-based recommendations; however, little evidence has been reported on the success of adherence to a clinical practice guideline (CPG) for asthma in the emergency department (ED) setting.[3–5]

The current literature supports the use of evidence-based CPGs.[6–10] However, the adherence to the guidelines by health care personnel has been poor. Barriers to adherence to CPGs may be attributed to a variety of circumstances.[11] Changing the way physicians practice medicine includes providing proper education regarding the CPG and its usefulness in enhancing outcomes as well as providing adequate feedback regarding those outcomes.[12] A guideline that has had extensive review and critique by those using it has been shown to encourage utilization of a CPG.[13]

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TABLE 1. Guidelines for Disposition Decision

Discharge home
- O_2 saturation >92% on room air
- PEFR ≥70% predicted
- ASS-R ≤3

Admit to observation unit
- O_2 saturation >90% on room air
- PEFR ≥50% predicted
- ASS-R <7
- Clinical impression for need of albuterol nebulizer treatments < every 4 hours

Admit to inpatient unit
- O_2 saturation <90% on room air
- PEFR <50% predicted
- ASS-R >3 but <7
- Clinical impression for need of albuterol nebulizer treatments < every 4 hours

Admit to pediatric intensive care unit
- O_2 saturation <90% on room air on 50% oxygen
- ASS-R >6
- Evidence of respiratory insufficiency by blood gas analysis
- Clinical impression for need of continuous albuterol nebulization

O_2 = oxygen; PEFR = peak expiratory flow rate; ASS-R = Asthma Severity Score, Revised.

This study was designed to: 1) evaluate provider adherence to an NAEPP-based ED CPG for acute childhood asthma and 2) to evaluate potential barriers to provider adherence such as patient age, illness severity (both acute and chronic), and high ED volume periods.

METHODS

Study Design. A prospective, cohort design was used and subjects were eligible to participate in the study if: 1) they were 1–18 years old diagnosed as having an exacerbation of asthma (children under 2 years old were excluded during the winter months), 2) they received all of their acute treatment from our ED, and 3) they had the CPG used to guide provider assessment and treatment. Inclusion as a study subject to assess provider adherence required all of the above criteria to be met. The institutional review board approved this study at Connecticut Children's Medical Center.

Study Setting and Population. The clinical setting is an urban pediatric ED that has a census of approximately 35,000 visits per year.

Patients were selected if they either required admission to the hospital [observation unit (OU), inpatient unit (IU), or pediatric intensive care unit (PICU)] or, on randomly selected days throughout the year, they were discharged to home after ED asthma care. This sampling strategy was used to obtain comparable numbers of subjects within three disposition groups (home; admitted to OU; admitted to IUs, including PICU).

Study Protocol. An asthma care committee was convened in 1997 for the purpose of developing a clinical pathway for asthma that included the ED, IUs, and PICU. This committee comprised physicians (pulmonology, emergency medicine, critical care, and general pediatrics), nurses, respiratory therapists, pharmacists, and nutritionists.

The ED CPG was based on the recommendations for acute exacerbations of asthma in the 1997 NAEPP report. This four-page guideline consisted of the following: page 1, overall algorithm for acute management of asthma based on illness severity; page 2, complete asthma history; page 3, assessment, including illness severity, peak flow, and pulse oximetry measurements and medications administered; and page 4, guidelines for disposition decision. The CPG was then pilot-tested over a six-month period to identify potential barriers to its use by the ED providers (i.e., attitudes reflecting how cumbersome or incomplete the CPG was for ED asthma care, style of form, and its ease of readability). Suggestions were included in the final CPG used for this study.

The ED-based CPG was used either when the patient was identified in triage as having asthma or after the patient was placed in a treatment room in the ED. The attending physician made the decision regarding disposition once the ED management was completed and utilized the guidelines on the CPG for disposition (Table 1) (discharge to

TABLE 2. Clinical Scoring System—Asthma Severity Score, Revised

Clinical Parameter	0	1	2	3
Accessory muscle use	None	Mild	Moderate	Severe
Wheezing	None, with good air exchange	End-expiratory	Inspiratory/expiratory, with good air exchange	Inspiratory/expiratory, with decreased air exchange
Respiratory rate (breaths/min)				
≤6 years	≤30	31–45	46–60	>60
>6 years	≤20	21–35	36–50	>50

Illness Severity Score: mild = 0–3; moderate = 4–6; severe = 7–9.

home, admission to the OU, IU, or PICU). Once disposition was made, patients were eligible to be subjects if admission was indicated or, on a random selection of days throughout the study period, patients were discharged to home.

Measurements.

Data Collection. Documentation of all relevant variables was recorded on the CPG, including all treatment provided in the ED. This included documentation of the chronic history of asthma, medications used (acute and chronic), the use of PEF at home, triggers of asthma, length of current episode, number of exacerbations, hospitalizations, and need for pediatric intensive care. Additionally, serial acute illness severity assessments were performed using a clinical score system (Table 2: Asthma Severity Score).[14]

All data were abstracted from the CPG and entered into a database using Teleform, software (Cardiff Software, Inc., Vista, CA) for electronic data scanning. Data were stored into Access, and SPSS version 9 (SPSS Inc., Chicago, IL) was used for the statistical analyses.

Outcome: Provider Adherence to CPG. Adherence was based on the NAEPP recommendations for an acute exacerbation of childhood asthma. Specific parameters included: at least three nebulized albuterol treatments in the first hour, as appropriate according to illness severity; early steroid administration (after the first nebulized albuterol treatment but before subsequent nebulized treatments, if indicated); clinical assessments using peak expiratory flow (PEF) for children more than 6 years old and pulse oximetry for all patients; and use of a clinical score system to assess illness severity (Asthma Severity Score), both at initial presentation and prior to a disposition decision. Nonadherence was defined as any deviation of the above adherence parameters during the ED care.

Factors considered possible markers of nonadherence included patient age, acute illness severity (mild, moderate, or severe using the Asthma Severity Score), chronic illness severity (mild, intermittent, or mild, moderate, or severe persistent using the NAEPP guidelines), first episode of wheezing, and high ED volume periods (evening shift, i.e., 4 PM–midnight, and weekends).

Data Analysis. Descriptive statistics for continuous variables are summarized by the mean and standard deviation; categorical variables are summarized as frequencies. Rates of provider adherence to the CPG with 95% confidence intervals (95% CIs) were calculated. The statistical significance of group differences was assessed using the chi-square tests or Fisher's exact test for categorical variables, and t-tests for continuously distributed variables. Stratified analyses of major variables expected to modify the outcome of adherence were performed using the Mantel-Haenszel test for stratified analyses.

TABLE 3. Description of the Study Population*

	Frequency	%
Age		
1–6 years	228	62
7–18 years	141	38
Ethnicity		
Hispanic	222	60
White	86	23
African American	57	15
Other	4	2
Source of primary care		
Private	163	46
Clinic	194	54
Insurance coverage		
Fee-for-service/private managed care	120	33
Medical assistance/managed medical assistance	235	63
Self-pay/none	14	4
Acute severity		
Mild	86	24
Moderate	212	59
Severe	62	17
Chronic severity		
Intermittent	179	49
Persistent	188	51
Disposition		
Home	139	38
Admission to observation unit	140	38
Admission to inpatient unit or pediatric intensive care unit	90	24
Complete adherence	250/369	68
Adherence (excluding peak expiratory flow)	305/369	83

*Different totals reflect missing data.

RESULTS

During the one-year study period, four hundred three patients were eligible for inclusion into the study and 369 subjects were enrolled (92%) (Table 3). Sixty-two percent of enrollees were under 7 years of age. Hispanic was the predominant ethnicity (60%) in our study population, and this is consistent with the patient demographics for our institution. Primary care was provided through private practices (46%), and, in 63% of all patients, medical assistance was the insurance coverage.

TABLE 4. Effect of Adherence* by Age, First Wheezing Episode, Illness Severity, and High Emergency Department (ED) Volume Periods

	Adherence	%	p-value
Age			
1–6 years	184/228	81	
>6 years	121/141	86	0.21
First wheezing episode			
Yes	32/41	78	
No	271/326	83	0.42
Acute severity (initial assessment)			
Mild	73/86	85	
Moderate	177/212	84	
Severe	54/62	87	0.78
Chronic severity			
Intermittent	148/179	83	
Persistent	156/188	83	0.94
High ED volume			
Shift			
Evening	148/169	88	
Day/overnight	138/177	78	0.02
Day			
Midweek	182/222	88	
Weekend	104/124	84	0.66

*Adherence when peak expiratory flow is excluded.

Twenty-four percent of the patients had mild exacerbations, 59% had moderate exacerbations, and 17% had severe exacerbations at initial presentation. Interrater reliability of acute illness severity using the clinical scoring system between physician and nurse observers on a subset (10% of the study population) produced excellent reliability with agreement of 94% and a kappa of 0.84. Just over 50% of patients had persistent asthma, defined by NAEPP. Using the CPG to guide the disposition decision, 38% were discharged to home, 38% were admitted to the OU, and 24% were admitted to the IU (inpatient units or PICU).

Complete adherence to the NAEPP recommendations for acute asthma management was 68% (95% CI = 63% to 73%). When the routine use of PEF for children older than 6 years was excluded, 83% (95% CI = 79% to 87%) of subjects received treatment adherent to the NAEPP guidelines. Of particular interest, only 41% (58/141) of children over 6 years of age with a prior history of asthma reported ever using a PEF meter to monitor their illness.

Analysis of possible contributing factors to nonadherence to the CPG is shown in Table 4. Excluding the use of PEF assessments, there were no differences in adherence to the CPG observed by age (≤6 years old, >6 years old, or 1–2 years old, 3–12 years old, 13 years old) or illness severity (acute and chronic). Although a statistically significant difference was noted with higher adherence to the CPG in the evening shift compared with the day or overnight shifts (p = 0.02), comparisons of midweek and weekend days revealed no differences (Table 4). Other variables such as first episode of asthma, asthma outpatient visits and/or hospitalizations in past year, history of ICU admission, insurance status, or source of primary care did not influence adherence to the CPG.

DISCUSSION

Provider adherence to CPGs has been evaluated in a variety of medical conditions, and a mean adherence rate of 54.5% has been reported in one meta-analysis.[15] This estimate is likely higher than routine practice given the potential bias of the Hawthorne effect[16,17] in populations being studied. Although our study also had this potential bias, an overall adherence rate of 68% is well above what has been reported in the literature, implying more than a Hawthorne effect was present in the rate of adherence to the CPG.

Additionally, if one excludes the routine use of PEF, adherence increased to 83%. Only 41% of children more than 6 years old had previously received instruction on its use based on initial parent interview. As such, many children were first introduced to its use during their acute exacerbations.

The NAEPP guidelines recommend routine use of PEF in all patients with moderate to severe persistent chronic asthma, as well as all patients who develop an acute exacerbation of their asthma.[2] However, less than two-thirds of physicians report use of PEF on patients in the ED due to a variety of factors.[18] An additional concern is the potential for false-negative measurements of PEF in the patient who has severe asthma.[19] For these reasons, we believe the routine use of PEF in the evaluation of an acute exacerbation of asthma is of limited value.

The NAEPP guidelines recommend the use of a clinical scoring system to assess illness severity; however, no specific score is recommended. We chose to use the Asthma Severity Score because of its extensive study as a well-validated asthma clinical scoring system in discriminating asthma severity,[20] as well as for its ease of use in the ED setting. This was readily adopted by our ED staff and became a routine part of care in evaluating children with asthma.

Challenges in recognizing acute bronchospasm in young children can lead to a delay in treatment or undertreatment. Additionally, severity of illness (both acute and chronic assessments) can influence the adherence to a standard ED-based asthma care plan. Most providers can identify a child with either severe or mild asthma; however, those patients with moderate asthma severity, or those pa-

tients without classic findings of respiratory distress, may be undertreated due to an inability to accurately assess severity. We found no differences in adherence to the CPG when adjusting for disease chronicity.

Environmental factors such as the patient volume in an ED setting may also influence provider adherence. We found significantly improved adherence (88%) during the busiest shift (evening); however, our staffing is upgraded during that shift to accommodate the increased volume. We found no differences in adherence patterns between weekend and weekdays.

Most of the work on guideline development has focused on the validity of the guideline[21–23]; however, other attributes of CPGs such as clinical applicability, flexibility, clarity, multidisciplinary process, and documentation are also important.[24,25] The development of our CPG for acute asthma included these important features, which enabled more consistent, effective, and efficient care.

LIMITATIONS AND FUTURE QUESTIONS

Our study was limited to one urban pediatric ED and, thus, our findings may not be applicable to other settings. We excluded patients who presented to other EDs prior to being transferred to our facility. Given our objectives in evaluating the use of a CPG, this was a necessary exclusion. We achieved a 92% enrollment rate of eligible subjects, which would make any selection bias of these subjects unlikely.

We also used a randomization scheme to select representative days throughout the year to enroll subjects who were being discharged. This sampling strategy attempted to provide three equally distributed groups of patients to study (subjects discharged home, admitted to the OU, and admitted to the IU) and enabled us to enroll subjects over the course of one year; however, this may have selected a sicker study population. This strategy avoided the potential of any seasonal bias, which we believed was an important issue to address in asthma patients.

These data provide evidence that the use of CPGs in a busy ED setting can be used consistently and effectively in the care of asthmatic children. Whether provider adherence to a CPG for acute asthma can influence the outcomes once the patient is discharged has yet to be determined.

CONCLUSIONS

Clinical practice guidelines can be used in the pediatric ED successfully in the treatment approach to acute exacerbations of childhood asthma. With a systematic and concise CPG, barriers to adherence in a pediatric ED appear to be minimal, with the exception of using PEF in the routine ED assessment.

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